

Biodiesel

Use of biodiesel in the United States has increased significantly in the last few years. As of May 2004 there were more than 400 major fleets using biodiesel, including all branches of the US military, Yellowstone National Park, NASA, several state departments of transportation, major public utility fleets such as Florida Power & Light, cities such as Berkeley, California, and more than 50 school districts. More than 1000 petroleum distributors make biodiesel available to farmers and other consumers, and more than 200 retail pumps now make the fuel available to the public. Studies have shown that if every diesel vehicle on the road today used five percent biodiesel, the United States would displace the equivalent of 1.7 billion gallons of foreign oil.

What is Biodiesel?

Biodiesel, a domestic, renewable fuel for diesel engines, is a methylester produced from a variety of oil sources including corn oil, peanut oil, canola oil, fry oil, and soybean oil.

Biodiesel is a fuel that is compatible with diesel engines, displaces imported petroleum, and reduces harmful emissions. Biodiesel offers similar fuel economy, horsepower, torque, and haulage rates to petroleum diesel while providing superior lubricity. Biodiesel can be blended with petroleum diesel in any concentra-



tion and used in existing diesel engines with little or no modification.

With the rise of fuel prices, environmental concerns and a new biodiesel tax incentive, the idea of a cleaner petroleum-based diesel is on the rise. Biodiesel is made in the USA and is available in all 50 states. Biodiesel also presents an opportunity to help reduce America's dependence on foreign oil.

Significant milestones have been reached which include development of a fuel standard, U.S. Congressional recognition and qualification as an alternative fuel, engine manufacturer acceptance and positive public image and acceptance. But even though there have been positive advances, biodiesel still faces obstacles to commercial viability. The primary obstacle

is the cost of biodiesel, which is currently \$2 to \$3+ per gallon. The components that contribute the most to biodiesel fuel costs are (1) feedstock costs, (2) byproduct values and (3) production costs.

INL's Innovation

In 1995 researchers at the Idaho National Laboratory (INL) became familiar with the technical limitations inherent with the existing biodiesel production processes. INL researchers, who have been active in the area of heterogeneous catalysis in alternative solvent systems, applied advanced engineering and process chemistry principles to biodiesel synthesis and conceptualized a process specifically targeted towards processing food industry oil

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and fat byproducts. The biodiesel synthesis process is based on a continuous, heterogeneous catalytic reaction, which uses a solid catalyst that is not solubilized into the reaction medium.

By employing a continuous, heterogeneous catalytic system, process limitations associated with the current batch method are significantly reduced because it:

- Provides higher throughputs,
- Reduces process costs and generates less waste,
- Creates a single reaction phase and overcomes mass transport limitations imposed by multi-phase liquid/liquid systems,

- Allows for efficient separations, and
- Limits the amount of water, which can contaminate the reaction.



Although other researchers have explored liquid solvents such as benzene and toluene to improve transesterification reaction rates, the INL proprietary solvent is preferred since it is non-toxic, non-flammable, non-hazardous, is not regulated under RCRA, is fully recyclable, and does not impart any negative qualities to the products as would toluene or benzene. The solvent is inexpensive and commercially available in large quantities. It also allows for high loading of oil and

fatty acids and can be utilized as a pre-treatment step for feedstock of extremely low quality to selectively strip out the desired reaction components and leave behind non-reacting materials.

Partnering with the INL

The INL is soliciting interest from qualified industrial firms interested in research and development opportunities. It is anticipated that the project will be carried out through a Cooperative Research and Development Agreement with funding support being provided by the participant(s). The INL has a patent on the process. See U.S. Patent No. 6,887,283. The INL invites interested parties to contact us regarding the details of implementing this technology into an operation.

An Alternative Fuel

Benefits from using biodiesel:

- Provides 78.5% reduction in carbon dioxide emissions compared to petroleum diesel
- Higher cetane number than US diesel fuel
- High fuel lubricity and oxygen content
- Highest BTU content of any alternative fuel
- Safest fuel to use, handle, and store
- Reduces particulates released into the atmosphere
- Lessens U.S. dependence on imported oil
- Decreases fuel consumption
- Reduces public health risks associated with air pollution
- Provides a higher flash point than petroleum diesel
- Can be stored in diesel tanks and pumped with regular equipment
- Reduces unpleasant odors
- Provides quieter operating equipment and better engine performance
- Highest energy balance of any fuel
- Biodegrades as fast as sugar
- 10 times less toxic than salt
- Supports U.S. farmers by providing a market for excess soybean oil